names. The volume is of moderate size and well printed, but the introduction of keys, especially in case of some of the larger genera, would have added somewhat to the usefulness of the work in the identification of species. Nevertheless, as a catalogue of the known species of the islands, it is a commendable contribution to taxonomic literature and will serve as an excellent basis for future studies on the flora of the region.—J. M. GREENMAN.

**Natürlichen Pflanzenfamilien.**[4]—Parts 236 and 237 contain a supplement to the Conjugatae and Chlorophyceae by the distinguished algologist Professor N. WILLE. Two new genera are included, namely *Pseudopringsheimia* and *Pseudulvella* of the Chaetophoraceae; the former is based on *Ulvella confluens* Rosenv., an epiphyte growing on marine algae of the north Atlantic; the latter is based on *Ulvella americana* Snow, also an epiphyte, and occurs on freshwater algae of North America. Parts 238–240, likewise of recent issue, consist of a general index to Teil I of this great work.—J. M. GREENMAN.

## NOTES FOR STUDENTS

**The life history of Griffithsia.**—LEWIS[5] has published a paper on the life history of *Griffithsia Bornetiana*. The paper begins with the presentation of the vegetative characters of the three different individuals of this species: antheridial, procarpic, and tetrasporic. The author records comparative studies of the size of the cells in the three individuals, discusses the nature of intercellular connections, describes the division of chromatophores, and calls attention to the phenomenon of an approximate simultaneous occurrence of the nuclear divisions in multinucleate cells. There are then described the development of antheridia, cystocarps, and tetraspores; the methods of vegetative propagation; germination of spores; and tetraspore-like structures on sexual plants. The paper closes with a discussion of results, in which the author presents his views on alternation of generations in Griffithsia.

Some of the cytological results are as follows. The nuclei in Griffithsia are throughout their history very poor in linin. The chromatin of the resting nucleus, therefore, is not distributed on a linin reticulum, but is chiefly contained in a centrally placed, homogeneous nucleolus or "karyosome." As regards the mode of formation of chromosomes, the chromatin passes out of the nucleolus until the whole chromatin content is distributed through the nuclear cavity in the form of granules. These granules are much more numerous than the chromosomes, and probably by the fusion of separate granules chromosomes are formed. The number of chromosomes in the nucleus of vegetative cells in the tetrasporic plant

[4] ENGLER UND PRANTL, Die natürlichen Pflanzenfamilien, etc. 236 and 237 Lieferung. Conjugatae und Chlorophyceae von N. WILLE. Nachträge zum I. Teil, 2 Abt., Bogen 1–6, pp. 96; 238 bis 240 Lieferung. Register zu Teil I (vollständig), pp. 242. Leipzig: Wilhelm Engelmann. 1909. *M* 3, *M* 4.50.

[5] LEWIS, I. F., The life history of *Griffithsia Bornetiana*. Annals of Botany **23**:639–690. *pls. 49–53*. 1909.

seems to be with certainty fourteen, and that of the sexual plant is about seven. Spindle fibers are formed, apparently by the rearrangement of the linin thread, so that the spindle is intranuclear. Kinoplasmic caps are present only during the nuclear division. The changes in the nucleus of the tetraspore mother cells are striking. The nucleolus fragments into several rounded bodies of various sizes, which after continuous fragmentation yield 12–14 rounded masses of chromatin of about the same size. These bodies become again irregular in form, and fuse with one another, so that their number is reduced by more than half. This stage LEWIS considers to represent synapsis, but it differs from the usual type. Fourteen chromosomes then appear and are scattered in the nuclear cavity. After telophase of the first division in the tetraspore mother cell, the daughter nuclei rest before commencing the second division. In the sporelings from tetraspores about six or seven chromosomes appear; in those from carpospores the number has not been ascertained exactly, but the author believes them to be diploid. Cell division in sporelings occurs usually when about sixteen nuclei are present, so that the coenocytic condition is attained very early in Griffithsia. Tetraspore-like structures on an antheridial plant have been found in only one case out of all plants examined. In this structure the cleavage furrow either does not reach the center of the cell or no trace of it occurs. Nuclear conditions have not yet been followed thoroughly.

From the cytological evidence brought forth in this paper, LEWIS considers that there exists in *Griffithsia Bornetiana* an alternation of generations similar to that described for *Polysiphonia violacea* by the reviewer. The fusion nucleus, which contains fourteen chromosomes, produces the cystocarp in which are formed carpospores. The nuclei of tetrasporic plants contain fourteen chromosomes, and it seems reasonable therefore to assume that the tetrasporic plants arise from carpospores. In tetraspore formation the number is reduced one-half, and seven chromosomes enter the nucleus of the tetraspore. It seems probable that on germination the tetraspore gives rise to the individual whose nuclei contain seven chromosomes and which bears sexual organs.

As to whether the alternation of generations in Griffithsia is to be regarded as antithetic or homologous, the conclusions are as follows: (1) "There is in Griffithsia an antithetic alternation of generations, the gametophyte being represented by the sexual plants, the sporophyte by the sporogenous cells of the cystocarp." (2) "In addition to this there is a regular succession of tetrasporic individuals and sexual individuals. The tetrasporic individuals resemble the sporophyte in the number of chromosomes; they resemble the gametophyte in morphological differentiation. They are to be considered as a phase of an homologous alternation of generations, not the equivalent, wholly or in part, of the sporophytes of archegoniates." To draw these conclusions, LEWIS has put more weight upon the two following factors than upon the fundamental chromosome difference between sporophytic and gametophytic nuclei: (1) the outer morphological similarity of the tetrasporic plant to the sexual plant; (2) the fact that either seems capable of producing the outer morphological equivalent of the reproductive

structures of the other, although the real nature of the structures has not yet been determined.—SHIGÉO YAMANOUCHI.

**Development and biology of Armillaria.**—FISCHER,[6] of the Indian Forest Service, has given a brief but interesting account of the development of the fruit bodies of *Armillaria mucida* Schräd., an agaric with a very slimy outer surface, which is common in parts of Europe, growing often in dense tufts on certain of the hard-wood trees. There is a thin universal veil present from the primordium stage to the time that the fruit body is rapidly expanding, which consists of interwoven threads forming a layer two or three cells deep. In an early stage of the primordium a palisade layer of cells is formed over its convex upper surface, just underneath the universal veil. This marks off the pileus, which now begins to expand laterally, also loosening the fundamental tissue between its lower margin and the future stipe, thus providing for the gill cavity, while at the same time the development of a palisade layer is continued from the margin inward over the roof of the gill cavity to form the primordium of the hymenium. The loose fundamental tissue between the margin of the pileus and the outer surface of the stem forms the partial veil. The slime which covers the plant is formed from the mucilaginization of the outer ends of the palisade tissue on the surface of the pileus.

The writer states (p. 504) that the present reviewer "seems to accept HARTIG'S account of the development in *Armillaria mellea* as substantially correct." Thus is discretion in the matter of not prejudging a case which is under investigation rewarded! A study of the development of *Armillaria mellea* was made by the reviewer several years ago, and an account[7] of it was presented before Section G of the A. A. A. S. at the New Orleans meeting, in connection with that on *Agaricus campestris*, the latter of which was published.[8] He has been holding the work on *Armillaria mellea* for some further study to clear up some details. There is nothing in this paper on *Agaricus campestris* which can be construed as either supporting or contradicting HARTIG'S account, and the writer carefully held to neutral ground.

It is to be hoped that FISCHER will continue his studies in the Agaricaceae, and that others also may be induced to undertake similar work. But it is just as much to be desired that either good photomicrographs be used to illustrate the work, or that good drawings be made, for little praise can be given to the illustrations accompanying this otherwise creditable paper.—GEO. F. ATKINSON.

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[6] FISCHER, C. C. E., On the development of the fructification of *Armillaria mucida* Schräd. Annals of Botany **23**:503–507. *pl. 35. figs. 1–7.* 1909.

[7] ATKINSON, GEO. F., The development of *Armillaria mellea;* the development of *Agaricus campestris.* Proc. A. A. A. S. 53rd Meeting, Dec. 1905—Jan. 1906. *Ibid.* Science N. S. **23**:203. 1906.

[8] ———, The development of *Agaricus campestris.* BOT. GAZETTE **43**:215–221. *pls. 7–12.* 1906